Form ESA-B4. Summary Report for ESA-171-2
Public Report - Final

Company	American Axle and Manufacturing	**ESA Dates**	September 18-20
Plant	Tonawanda Forge	**ESA Type**	Pumps
Product	Drive line components	**ESA Specialist**	Gunnar Hovstadius

Brief Narrative Summary Report for the Energy Savings Assessment:

Introduction: American Axle & Manufacturing (AAM) is a world leader in the design, engineering, testing, validation and manufacturing of driveline, drive-train and chassis systems, related components, and metal formed products for light trucks and buses, sport utility vehicles, crossover vehicles, and passenger cars. Metal formed products are the foundation of the AAM product line at the Tonawanda Forge. The plant located in Tonawanda, New York, forges high-quality net shaped differential gears, axle shafts, wheel spindles, rod caps, ring gears, tie rods, and relay rods. The Tonawanda Forge offers the state-of-the-art, world-class quality, low-cost products.

Tonawanda Forge Facility

2390 Kenmore Avenue
Tonawanda, NY 14150-7847

Objective of ESA:

a) To train company/plant personnel in the use of the DOE PSAT software
b) To perform a “training assessment” of plant equipment to demonstrate how to use the tool and find savings in the process of doing so.

Focus of Assessment:

The assessment focused on the water cooling system for four hot-formers and on two de-scaling pumps.

During the ESA the following tasks were performed:

- Reviewed the operation of the de-scaling and water cooling systems at AAM, Tonawanda
- Estimated energy use at different pump installations
- Held seminar on basic pump knowledge and demonstration on how to use PSAT and the Valve Tool
- Assessment based on field data gathered during the ESA
- Reviewed energy use and pump reliability issues

Approach for ESA:

Pre assessment activity: The plant sent information before the ESA concerning two high pressure pitot pumps used for de-scaling applications in the forge presses. Both were 200HP pumps with one operating at a time. Weir Corporation was contacted to obtain more information on the characteristics and operation of these pumps. The purpose of the high pressure water is to clean scale off the production parts (bars/billets), prior to forging, to avoid inclusion of surface impurities into the finished material. (When arriving at the plant it was found that the plant had already gone ahead and installed a VFD to drive these pumps).

First day at the plant:

Introductions and background

Objectives & Agenda

Overview of why it is important to assess pump systems. The ESA expert presented the relationships between energy efficiency, reliability and maintenance costs. Demonstrated how the tools are used.

Plant Tour –

Identification of equipment or systems to evaluate using PSAT

The plant suggested that we concentrate on the pitot pumps in the de-scaling system for the forge presses and the water cooling system for four hot-formers

Classroom Training

Introduction to industrial pump systems

PSAT training

Second day:

Measurements & Data Gathering on equipment and systems.

It turned out that the factory had already installed a variable speed drive for the pitot pumps so we concentrated on the present operating conditions and verifying the savings. Pressures at the roto-jet pump was recorded and used as input to the valve tool. The roto-jet pump is not represented in PSAT so the performance curve was used to estimate efficiency.

Next we looked at the water cooling systems for the hot-formers. It turned out that these pumps are being run continuously even when a hot-former is stopped for re-tooling or for other reasons. The plant engineer estimated that the hot-formers are running about 50% of the time and idling 50%. During such shut-downs or idling of the hot-formers the cooling water was re-directed back to the sump below the hot-formers through a flow limiting device. The reason for running the pumps was fear of loosing prime and to some extent cleaning of the flume below the hot-former. Pressure measurements were taken at different points of the cooling systems during hot-former operation. Power was also measured.

Measurements, as usual, turned out to be a bit of a challenge, but the plant people were very helpful.

The ESA expert worked closely with the plant personnel involved in the ESA to examine and input the data collected into PSAT and the valve tool. The results were compared to pump curves and the flow estimated from the pressure and power measurements. The plant people were competent and engaged in the process.

Third day:

Continued taking measurements and analyzed findings

The results and findings were presented to the plant maintenance manager, Mark Schimley.

Results: Cooling water pumps

- The measurements showed that all cooling pumps operated high up on their respective curves with efficiencies around 40-50%. At BEP these pumps should be 78-80% efficient depending on impeller diameter.
- When the hot-formers idle or are shut down, the pumps continue to operate, but the flow is redirected through a flow limiter to the flume below the hot-former. The resistance in these loops is about 10 PSI lower than through the operational loop and the flow and power therefore increase when the flow is redirected.
- Some pump motors had been changed from 60 to 100HP. Why, was not clear, but it was assumed that this had been done in order to ensure a higher pressure from the system. The power draw for the pumps is well below 60 HP so this change of motors would not help that situation, but rather make the 100HP motors run lightly loaded.

Recommendations: Cooling water pumps

- Shut down the cooling pumps when not needed. This could for example be done by reprogramming the PLC so that the pumps stop automatically a certain time after the hot-former is stopped. All systems have recently got new foot valves and the sumps have been cleaned so the risk of loosing prime should have been eliminated.

- The cooling water pumps presently supply cooling water to one internal loop inside the tools and one external loop showering the tools from the outside. The internal loop requires above 80 PSI in order to function properly, whereas the external shower heads operate at about 20 PSI.

- The internal cooling seems to be a very critical item for tool longevity. It would therefore be prudent to investigate if an increase in pressure for the internal cooling system would have positive benefits on tool life.

- Investigate if the cooling loops can be split into one or more high pressure loops with redundancy built in and one or more low pressure loops.

- Each hot-former has its own pump system. The required head for the external tool cooling is much smaller than what the present pumps supply (20 vs 100 PSI). Some of the existing pumps could possibly be used to supply several hot-formers with high pressure water. Such an arrangement could also be controlled by a VFD if several hot-formers were run from one system in order to accommodate for the varying flow rates that occur when different number of hot-formers are operating. Care has to be taken that the internal cooling needs are met.

- If separate systems are used for each hot-former, pumps with lower flow rates operating closer to their BEPs would save both on energy and maintenance costs.

- Additional low pressure pumps could handle the external cooling of the tools at lower energy cost

- Use the appropriate motor size for a pump

Observations and recommendations: Pitot pumps

- The pitot pumps were pumping mill water into an accumulator that in turn delivers water to spray nozzles that clean a press from scale after each pressing cycle. The pressure in the accumulator was essentially constant during the operation.

- The installed VFD for the pitot pumps could save about $18 000/ year compared to running the pumps at full speed. This is if the pressure is limited to about 1150 PSI compared to the full speed pressure of 1900 PSI. However, the program settings made the pump deliver 1600 PSI periodically. This pressure was read repeatedly at the pumps. Why that is, was not clear, but assumed to be the result of some algorithm in the program controlling the VFD.

- The program should be reviewed and modified so that the pumps are not running at higher than necessary speeds/pressures.

- The maintenance cost for these pumps has been extremely high, costing the plant around $100 000 per year. The total cost of installing the VFD amounted to $35,000 so the payback should be rather short if the pumps are run at the correct speed.

- An added advantage with the VFD is that the outlet pressure can be easily changed to the correct level needed for cleaning.

General Observations of Potential Opportunities:

Usage numbers for calendar year 2006 AAM Tonawanda:

Electric usage: over 65,000,000 kwh, cost: $3.6 million
Natural gas usage: over 175,000 dth, cost: $1.3million

Since the plant is a forge there is a lot of process heating going on. A closer look at the heating processes might be useful.

Opportunity 1 (short term)

- Make sure that the pitot pumps are run at the correct speed and not delivering higher head than necessary

Opportunity 2 (short term)

- Shut down the cooling pumps when not needed

Opportunity 3 (medium term)

- Use pumps that are better suited for the duty, operating closer to their respective BEP. (Payback time may be a problem)

Other opportunities and best practices (not quantifiable at this time)

Medium term opportunities would include:

- Separate the hot-former cooling systems into high and low pressure systems. The pressure in the high pressure internal cooling system should be optimized for maximum tool life

- The low pressure part would then be supplied by low head pumps avoiding throttling losses

Management Support and Comments: Received full support from the plant maintenance manager and the corporate energy manager.

“It was a blast for me”
“Very interesting presentation”

DOE Contact at Plant/Company:
Afif Bitar, PE, CEM
Director Corporate Facilities & Power Distribution
Corporate Headquarters, Detroit, Michigan